CLAIMS

1. An operation device having one or more encoders, operation means for operating one or more outputs of the one or more encoders, and one or more decoders for decoding one or more outputs of the operation means, and replacing one or more operations of an original operation system defined on first representation data, with one or more operations of a new operation system of the operation means defined on second representation data, characterized in that:

a set of the first representation data of the original operation system is a set B_r^n (a direct product of n sets B_r of r values) with a base number of r and a word length of n such as to satisfy $\max\{|\Omega_{G^q}in|,|\Omega_{F^p}in|,|\Omega_{H^s}in|,|\Omega_{G^q}out|,|\Omega_{F^p}out|,|\Omega_{H^s}out|\} \le r^n$, where $|\Omega_{G^q}in|$, $|\Omega_{F^p}in|$, $|\Omega_{H^s}in|$, $|\Omega_{G^q}out|$, $|\Omega_{F^p}out|$, $|\Omega_{H^s}out|$ are cardinal numbers of one or a plurality (Q+P+S>=1) of finite sets $\Omega_{G^q}in$, $\Omega_{F^p}in$, $\Omega_{H^s}in$, and $\Omega_{G^q}out$, $\Omega_{F^p}out$, $\Omega_{H^s}out$ for input space and output space of the original operation system in which original operation system Q unary operations $G^q\colon \Omega_{G^q}in \to \Omega_{G^q}out\ (q=1,2,\cdots,Q,)$,

and/or P binary operations $F^p\colon \Omega_{F^p}in \times \Omega_{F^p}in \to \Omega_{F^p}out \quad (p=1,2,\cdots,P)$,

and/or S T-nary operations $F^p\colon \Omega_{F^p}in \times \Omega_{F^p}in \to \Omega_{F^p}out \quad (p=1,2,\cdots,P)$

are defined;

unless $|\Omega in|=r^n$ for a cardinal number $|\Omega in|$ of a set of data Ωin (any of $\Omega_{G^q}in$, $\Omega_{F^p}in$, $\Omega_{H^s}in$) of input space of any of the operation of the original operation system, relationships for $r^n-|\Omega|$ undefined elements are added to the any of the operation of the original operation system;

the Q unary operations G^q of the original operation system are extended to unary operations $G^q{}_O\colon B_r^n \to B_r^n\ (q=1,2,\cdots,Q)$, the P

binary operations F^p is extended to binary operations $F^p{}_O$: $B_r{}^n \times B_r{}^n \rightarrow B_r{}^n$ $(p=1,2,\cdots,P)$, and the S T-nary operations H^s is extended to T-nary operations $H^s{}_O$: $B_r{}^n \times B_r{}^n \times \cdots \times B_r{}^n \rightarrow B_r{}^n$ (the number of direct products is T, $s=1,2,\cdots,S$);

the second representation data is data on a set $B_r{}^m$.($m \geq n$);

the one or more encoders function as injective mappings $\Phi : B_r{}^n \rightarrow B_r{}^m$;

the one or more decoders function as surjective mappings $\Psi : B_r{}^m \rightarrow B_r{}^n$;

the operation means operates as one or more unary operations $G^q{}_N$: $B_r{}^m \rightarrow B_r{}^m$ of the new operation system corresponding to $G^q{}_O$, as one or more binary operations $F^p{}_N$: $B_r{}^m \times B_r{}^m \rightarrow B_r{}^m$ of the new operation corresponding to $F^p{}_O$, and/or as one or more T-nary operations $H^s{}_N$: $B_r{}^m \times B_r{}^m \times \cdots \times B_r{}^m \rightarrow B_r{}^m$ of the new operation system corresponding to $H^s{}_O$;

whereby all operations of the original operation system and all operations, encoders and decoders of the new operation system are related to mappings of an r- value logic type having plural inputs and outputs; and,

a code $[X]$ ($[X] \subset B_n{}^m$) corresponding to every one of X on $B_r{}^n$ satisfies following expressions (1) to (5),

(1) $\Phi(X) \in [X] \subset B_r{}^m$ (for $\forall X \in B_r{}^n$)

(2) $\Psi([X]) = X$ (for $\forall X \in B_r{}^n$)

(3) $Y = G^q{}_O(X) \Leftrightarrow [Y] \supset G^q{}_N([X])$ (for $\forall X,Y \in B_r{}^n$, $\forall q$)

(4) $Z = F^p{}_O(X,Y) \Leftrightarrow [Z] \supset F^p{}_N([X],[Y])$ (for $\forall X,Y,Z \in B_r{}^n$, $\forall p$)

(5) $Y = H^s{}_O(X_1,\cdots,X_T) \Leftrightarrow [Y] \supset H^s{}_N([X_1],\cdots,[X_T])$ (for $\forall X_1,\cdots,X_T,Y \in B_r{}^n$, $\forall s$).

2. An operation device having one or more encoders, operation means for operating one or more outputs of the one or more encoders, and one or more decoder for one or more outputs of the operation means, and replacing one or more operations of an original operation system defined on first representation data, with one or more operations of a new operation system of the operation means defined on second representation data, characterized in that:

a set of the first representation data of the original operation system is a set B_r^n (a direct product of n sets B_r of r values) with a base number of r and a word length of n such as to satisfy $\max\{|\Omega_{G^q}in|,|\Omega_{F^p}in|,|\Omega_{H^s}in|,|\Omega_{G^q}out|,|\Omega_{F^p}out|,|\Omega_{H^s}out|\} \leq r^n$, where $|\Omega_{G^q}in|$, $|\Omega_{F^p}in|$, $|\Omega_{H^s}in|$, $|\Omega_{G^q}out|$, $|\Omega_{F^p}out|$, $|\Omega_{H^s}out|$ are cardinal numbers of one or a plurality (Q+P+S□1) of finite sets $\Omega_{G^q}in$, $\Omega_{F^p}in$, $\Omega_{H^s}in$, and $\Omega_{G^q}out$, $\Omega_{F^p}out$, $\Omega_{H^s}out$ for input space and output space of the original operation system in which original operation system Q unary operations G^q: $\Omega_{G^q}in \rightarrow \Omega_{G^q}out$ $(q = 1,2,\cdots,Q,)$,

and/or P binary operations F^p: $\Omega_{F^p}in \times \Omega_{F^p}in \rightarrow \Omega_{F^p}out$ $(p = 1,2,\cdots,P)$,

and/or S T-nary operations F^p: $\Omega_{F^p}in \times \Omega_{F^p}in \rightarrow \Omega_{F^p}out$ $(p = 1,2,\cdots,P)$

are defined;

unless $|\Omega in| = r^n$ for a cardinal number $|\Omega in|$ of a set of data Ωin (any of $\Omega_{G^q}in$, $\Omega_{F^p}in$, $\Omega_{H^s}in$) of input space of any of the operation of the original operation system, relationships for $r^n - |\Omega|$ undefined elements does are added to the any of the operation of the original operation system;

the Q unary operations G^q of the original operation system are extended to unary operations $G^q o$: $B_r^n \rightarrow B_r^n$ $(q = 1,2,\cdots,Q)$, the P

binary operations F^p is extended to binary operations $F^p{}_O: B_r{}^n \times B_r{}^n \to B_r{}^n \quad (p=1,2,\cdots,P)$, and the S T-nary operations H^s is extended to T-nary operations $H^s{}_O: B_r{}^n \times B_r{}^n \times \cdots \times B_r{}^n \to B_r{}^n$ (the number of direct products is T, $s=1,2,\cdots,S$);

the second representation data is data on a set $B_r{}^m$ ($m \geq n$);

the one or more encoders function as injective mappings $\Phi : B_r{}^n \to B_r{}^m$;

the one or more decoders function as surjective mappings $\Psi : B_r{}^m \to B_r{}^n$;

the operation means operates as one or more unary operations $G^q{}_N: B_r{}^m \to B_r{}^m$ of the new operation system corresponding to $G^q{}_O$, as one or more binary operations $F^p{}_N: B_r{}^m \times B_r{}^m \to B_r{}^m$ of the new operation corresponding to $F^p{}_O$, and/or as one or more T-nary operations $H^s{}_N: B_r{}^m \times B_r{}^m \times \cdots \times B_r{}^m \to B_r{}^m$ of the new operation system corresponding to $H^s{}_O$;

whereby all operations of the original operation system and all operations, encoders and decoders of the new operation system are related to mappings of an r- value logic type having plural inputs and outputs; and,

a code $[X]$ ($[X] \subset B_n{}^m$) corresponding to every one of X on $B_r{}^n$ satisfies following expressions (1c) to (5c),

(1c) $\chi'_{[X]}(\Phi(X)) = 1$ (for $\forall X \in B_r{}^n$)

(2c) $\chi_X(\Psi([X])) = 1$ (for $\forall X \in B_r{}^n$)

(3c) $\chi'_{[G^q{}_O(X)]}(G^q{}_N([X])) = 1$ (for $\forall X \in B_r{}^n$, $\forall q$)

(4c) $\chi'_{[F^p{}_O(X,Y)]}(F^p{}_N([X],[Y]) = 1$ (for $\forall X, Y \in B_r{}^n$, $\forall p$)

(5c) $\chi'_{[H^s o(X_1,\cdots,X_T)]}(H^s{}_N([X_1],\cdots,[X_T])=1$ (for $\forall X_1,\cdots,X_T \in B_r{}^n$, $\forall s$).

3. An operation device design method comprising computer executed steps of:

generating a code $[X]$ ($[X]\subset B_n{}^m$) corresponding to each one of X on $B_r{}^n$ satisfies following expressions (1) and (2),

(1) $\Phi(X)\in[X]\subset B_r{}^m$ (for $\forall X\in B_r{}^n$)

(2) $\Psi([X])=X$ (for $\forall X\in B_r{}^n$)

where a set of the first representation data of the original operation system is a set $B_r{}^n$ (a direct product of n sets B_r of r values) with a base number of r and a word length of n such as to satisfy $\max\{|\Omega_{G^q}in|,|\Omega_{F^p}in|,|\Omega_{H^s}in|,|\Omega_{G^q}out|,|\Omega_{F^p}out|,|\Omega_{H^s}out|\}\le r^n$, where $|\Omega_{G^q}in|$, $|\Omega_{F^p}in|$, $|\Omega_{H^s}in|$, $|\Omega_{G^q}out|$, $|\Omega_{F^p}out|$, $|\Omega_{H^s}out|$ are cardinal numbers of one or a plurality (Q+P+S□1) of finite sets $\Omega_{G^q}in$, $\Omega_{F^p}in$, $\Omega_{H^s}in$, and $\Omega_{G^q}out$, $\Omega_{F^p}out$, $\Omega_{H^s}out$ for input space and output space of the original operation system in which original operation system Q unary operations $G^q\colon \Omega_{G^q}in\to\Omega_{G^q}out$ $(q=1,2,\cdots,Q,)$,

and/or P binary operations $F^p\colon \Omega_{F^p}in\times\Omega_{F^p}in\to\Omega_{F^p}out$ $(p=1,2,\cdots,P)$,

and/or S T-nary operations $F^p\colon \Omega_{F^p}in\times\Omega_{F^p}in\to\Omega_{F^p}out$ $(p=1,2,\cdots,P)$

are defined; unless $|\Omega in|=r^n$ for a cardinal number $|\Omega in|$ of a set of data Ωin (any of $\Omega_{G^q}in$, $\Omega_{F^p}in$, $\Omega_{H^s}in$) of input space of any of the operation of the original operation system, relationships for $r^n-|\Omega|$ undefined elements does are added to the any of the operation of the original operation system; the Q unary operations G^q of the original operation system are extended to unary operations $G^q o\colon B_r{}^n\to B_r{}^n$ $(q=1,2,\cdots,Q)$, the P binary operations F^p

is extended to binary operations $F^p{}_O: B_r{}^n \times B_r{}^n \to B_r{}^n$ $(p = 1,2,\cdots,P)$, and the S T-nary operations H^s is extended to T-nary operations $H^s{}_O: B_r{}^n \times B_r{}^n \times \cdots \times B_r{}^n \to B_r{}^n$ (the number of direct products is T, $s = 1,2,\cdots,S$); the second representation data is data on a set $B_r{}^m$ ($m \geq n$); one or more encoders function as injective mappings $\Phi : B_r{}^n \to B_r{}^m$; one or more decoders function as surjective mappings $\Psi : B_r{}^m \to B_r{}^n$; one or more unary operations of the new operation system corresponding to $G^q{}_O$ are such as $G^q{}_N: B_r{}^m \to B_r{}^m$; one or more binary operations of the new operation system corresponding to $F^p{}_O$ are such as of the new operation system corresponding to $G^q{}_O$, as one or more binary operations $F^p{}_N: B_r{}^m \times B_r{}^m \to B_r{}^m$ of the new operation corresponding to $F^p{}_O$; one or more T-nary operations of the new operation system corresponding to $H^s{}_O$ are such as $H^s{}_N: B_r{}^m \times B_r{}^m \times \cdots \times B_r{}^m \to B_r{}^m$; whereby all operations of the original operation system and all operations, encoders and decoders of the new operation system are related to mappings of an r- value logic type having plural inputs and outputs;

generating one or more operations of the new operation system; and,

selecting, among the one or more operations thus generated, one or more operations satisfying following expressions,

(3) $Y = G^q{}_O(X) \Leftrightarrow [Y] \supset G^q{}_N([X])$ (for $\forall X, Y \in B_r{}^n$, $\forall q$)

(4) $Z = F^p{}_O(X,Y) \Leftrightarrow [Z] \supset F^p{}_N([X],[Y])$ (for $\forall X, Y, Z \in B_r{}^n$, $\forall p$)

(5) $Y = H^s{}_O(X_1,\cdots,X_T) \Leftrightarrow [Y] \supset H^s{}_N([X_1],\cdots,[X_T])$ (for $\forall X_1,\cdots,X_T, Y \in B_r{}^n$, $\forall s$).

4. An operation device design method comprising computer

executed steps of:

generating a code $[X]$ ($[X] \subset B_n^m$) corresponding to each one of X on B_r^n satisfies following expressions (1) and (2),

(1c) $\chi'_{[X]}(\Phi(X)) = 1$ (for $\forall X \in B_r^n$)

(2c) $\chi_X(\Psi([X])) = 1$ (for $\forall X \in B_r^n$)

where a set of the first representation data of the original operation system is a set B_r^n (a direct product of n sets B_r of r values) with a base number of r and a word length of n such as to satisfy $\max\{|\Omega_{G^q} in|, |\Omega_{F^p} in|, |\Omega_{H^s} in|, |\Omega_{G^q} out|, |\Omega_{F^p} out|, |\Omega_{H^s} out|\} \le r^n$, where $|\Omega_{G^q} in|$, $|\Omega_{F^p} in|$, $|\Omega_{H^s} in|$, $|\Omega_{G^q} out|$, $|\Omega_{F^p} out|$, $|\Omega_{H^s} out|$ are cardinal numbers of one or a plurality (Q+P+S□1) of finite sets $\Omega_{G^q} in$, $\Omega_{F^p} in$, $\Omega_{H^s} in$, and $\Omega_{G^q} out$, $\Omega_{F^p} out$, $\Omega_{H^s} out$ for input space and output space of the original operation system in which original operation system Q unary operations $G^q\colon \Omega_{G^q} in \to \Omega_{G^q} out$ ($q = 1, 2, \cdots$, Q,),

and/or P binary operations $\mathrm{F}^p\colon \Omega_{F^p} in \times \Omega_{F^p} in \to \Omega_{F^p} out$ $(p = 1, 2, \cdots, P)$,

and/or S T-nary operations $\mathrm{F}^p\colon \Omega_{F^p} in \times \Omega_{F^p} in \to \Omega_{F^p} out$ $(p = 1, 2, \cdots, P)$

are defined; unless $|\Omega in| = r^n$ for a cardinal number $|\Omega in|$ of a set of data Ωin (any of $\Omega_{G^q} in$, $\Omega_{F^p} in$, $\Omega_{H^s} in$) of input space of any of the operation of the original operation system, relationships for $r^n - |\Omega|$ undefined elements does are added to the any of the operation of the original operation system; the Q unary operations G^q of the original operation system are extended to unary operations $G^q o\colon B_r^n \to B_r^n$ $(q = 1, 2, \cdots, Q)$, the P binary operations F^p is extended to binary operations $\mathrm{F}^p o\colon B_r^n \times B_r^n \to B_r^n$ $(p = 1, 2, \cdots, P)$, and the S T-nary operations H^s is extended to T-nary operations $H^s o\colon B_r^n \times B_r^n \times \cdots \times B_r^n \to B_r^n$ (the number of direct products is

T, $s=1,2,\cdots,S$); the second representation data is data on a set B_r^m ($m \geq n$); one or more encoders function as injective mappings $\Phi: B_r^n \rightarrow B_r^m$; one or more decoders function as surjective mappings $\Psi: B_r^m \rightarrow B_r^n$; one or more unary operations of the new operation system corresponding to $G^q{}_O$ are such as $G^q{}_N$: $B_r^m \rightarrow B_r^m$; one or more binary operations of the new operation system corresponding to $F^p{}_O$ are such as of the new operation system corresponding to $G^q{}_O$, as one or more binary operations $F^p{}_N$: $B_r^m \times B_r^m \rightarrow B_r^m$ of the new operation corresponding to $F^p{}_O$; one or more T-nary operations of the new operation system corresponding to $H^s{}_O$ are such as $H^s{}_N$: $B_r^m \times B_r^m \times \cdots \times B_r^m \rightarrow B_r^m$; whereby all operations of the original operation system and all operations, encoders and decoders of the new operation system are related to mappings of an r- value logic type having plural inputs and outputs;

generating one or more operations of the new operation system; and,

selecting, among the one or more operations thus generated, one or more operations satisfying following expressions,

(3c) $\chi'_{[G^q{}_O(X)]}(G^q{}_N([X]))=1$ (for $\forall X \in B_r^n$, $\forall q$)

(4c) $\chi'_{[F^p{}_O(X,Y)]}(F^p{}_N([X],[Y])=1$ (for $\forall X,Y \in B_r^n$, $\forall p$)

(5c) $\chi'_{[H^s{}_O(X_1,\cdots,X_T)]}(H^s{}_N([X_1],\cdots,[X_T])=1$ (for $\forall X_1,\cdots,X_T \in B_r^n$, $\forall s$).

5. A logic function design method, characterized in that: finite sets are treated as sets on B^n;

(6) a characteristic function $\chi_S(X)$ ($S \subseteq B^n$, $X \in B^n$) of an

arbitrary subset S on B^n is treated as one n-variable Boolean function (characteristic logic function);

(7) each element of a set is related to a miniterm of B^n;

following relation expressions (8), (9), and (10) are satisfied where a characteristic logic function of a subset S ($S \subset B^n$) of B^n is denoted with $\chi_S(X)$ ($X \in B^n$), a characteristic logic function of a subset T ($T \subset B^m$) of B^m is denoted with $\chi'_T(Y)$ ($Y \in B^m$), and an image of a subset S of B^n by a mapping $F : B^n \to B^m$ is denoted with $F(S)$,

(8) $\chi_S(X) = \bigcup_{Q \in S} \chi_Q(X) = \bigcup_{Q \in S} X^Q$

(9) $\chi'_{F(S)}(Y) = \bigcup_{Q \in S} Y^{F(Q)}$

(10) $\chi'_{F(S)}(Y) = \bigcup_{X} Y^{F(X)} \cdot \chi_S(X)$; and,

following relation expressions (11) to (14) are satisfied for a subset $S, T \subset B^n$ of B^n,

(11) $\chi_S(X) \cdot \chi_T(X) = 0 \quad (for \quad \forall X \in B^n) \Leftrightarrow \quad S \cap T = \phi$

(12) $\chi_{S \cap T}(X) = \chi_S(S) \cdot \chi_T(X)$

(13) $\chi_{S \cup T}(X) = \chi_S(S) \cup \chi_T(X)$

(14) $\overline{\chi_S(X)} \cdot \chi_T(X) = 0 \quad (for \quad \forall X \in B^n) \Leftrightarrow S \supset T$;

further characterized by computer executed steps of:

inputting relation among sets;

translating the inputted relation among the sets to expressions of characteristic logic functions based on the relation expressions (8) to (14); and,

determining whether or not the translated characteristic logic functions are satisfied.

6. A logic function design method, characterized in that: a mapping $\mathrm{F} : \mathrm{B}^{\mathrm{n}} \rightarrow \mathrm{B}^{\mathrm{m}}$ composed of m n-variable Boolean functions $f_j(X)$ (where $X=(x_1,x_2,\cdots\cdots,x_n)$, j=1, 2, $\cdots\cdots,m$) defined on binary Boolean algebra B={0,1} are treated in a lump by a generating function defined with a following expression (16),

(16) $\widetilde{F}(Y,X)=Y^{F(X)}=\bigcap_{j=1}^{m}\{y_j f_j(X)\cup\overline{y}_j\overline{f_j(X)}\}$ (where $Y=(y_1,y_2,\cdots,y_m)$);

for an arbitrary function $g(Y)$ of $Y \in B^n$, the function $g(Y)$ is determined as a miniterm when a following expression (18) is satisfied,

(18) $\bigcup_{Y} g(Y)\cdot\widetilde{F}(Y,X)=g(F(X))$,

or, for an identity translation $I : B^n \rightarrow B^n$, a following expression (19) are satisfied,

(19) $\bigcup_{Y} g(Y)\cdot\widetilde{I}(Y,X)=g(X)$,

or relation of following expressions (20), (21), (22) and (27) among component functions $f_j(X)$ a mapping F and the generation function are satisfied,

(20) $f_j(X)=\bigcup_{Y} y_j\cdot\widetilde{F}(Y,X)$

(21) $\overline{f_j(X)}=\bigcup_{Y}\overline{y_j}\cdot\widetilde{F}(Y,X)$

(27) $\widetilde{F}(Y,X)\cdot\widetilde{F}(Z,X)=\widetilde{F}(Y,X)\cdot\widetilde{I}(Y,Z)$,

or, following expressions (15) and (17) where a composite mapping of a mapping $\mathrm{F} : \mathrm{B}^{\mathrm{n}} \rightarrow \mathrm{B}^{\mathrm{m}}$ and a mapping $G : B^m \rightarrow B^l$ is denoted with

$R : B^n \to B^l$,

(15) $Z^{R(X)} = \bigcup_Y Z^{G(Y)} \cdot Y^{F(X)}$

(17) $\widetilde{R}(Z,X) = \bigcup_Y \widetilde{G}(Z,Y) \cdot \widetilde{F}(Y,X)$,

or, for the characteristic logic function with $\Omega = B^n$ following relation expressions (22) and (23) are satisfied,

(22) $\bigcup_Y \widetilde{F}(Y,X) = \chi_\Omega(X) = 1$

(23) $\bigcup_X \widetilde{F}(Y,X) = \chi'_{F(\Omega)}(Y)$,

or, for an isomorphic mapping $\Phi : \Omega \to \Omega$ on $\Omega = B^n$, following relation expressions (24), (25), and (26) are satisfied from definition (16) of the generating function, where an inverse mapping is denoted by Φ^{-1}: $\Omega \to \Omega$,

(24) $\widetilde{\Phi}^{-1}(X,Y) = \widetilde{\Phi}(Y,X)$ (for $X,Y \in \Omega$)

(25) $\phi^{-1}{}_i(X) = \bigcup_Y y_i \cdot \widetilde{\Phi}(X,Y)$

(26) $\bigcup_Z \widetilde{\Phi}^{-1}(X,Z) \cdot \widetilde{\Phi}(Z,Y) = \bigcup_Z \widetilde{\Phi}(X,Z) \cdot \widetilde{\Phi}(Z,Y) = \widetilde{I}(X,Y)$ (for $\forall X,Y,Z \in \Omega$),

or, for an arbitrary function $g(Y)$ of $Y \in B^n$, a following relation expression (28) is satisfied,

(28) $\bigcup_Y \overline{\widetilde{I}(Z,Y)} \cdot g(Y) = \overline{g(Z)}$; and,

$\widetilde{F}(Y,X)$ is determined as a generating function of a mapping $B^n \to B^m$, when a following relation expression (29) is satisfied,

(29) $\bigcup_Y \overline{\widetilde{I}(Z,Y)} \cdot \widetilde{F}(Y,X) = \overline{\widetilde{F}(Z,X)}$ (for $\forall Y,Z \in B^m$, $\forall X \in B^n$);

the method further comprising computer executed steps of:

inputting each component function or a generating function of each mapping;

calculating the each component function and/or the generating function based on the expression (16);

calculating the expressions (18) to (29); and,

whereby .processes and determinations in connection with each mapping is treated in lump.

7. A logic function design method, characterized in that:

dependencies of a logic function $f(X)$ with variables $x_1, x_2, \cdots, x_n$ are analyzed by determining whether or not a following relation expression (30) is satisfied,

(30) $f(X)\cdot\overline{f(Y)}\cdot\Delta(X,Y)=0$,

or, by determining whether or not a following relation expression (31) using a generating function of a mapping is satisfied for component function for $f_j(X)$ ($j=1,2,\cdots,m$) of a mapping $F: B^n \to B^m$,

(31) $\widetilde{F}(X,A)\cdot\widetilde{F}(Y,B)\cdot x_j\cdot\overline{y_j}\cdot\Delta_j(A,B)=0$,

or, particularly, by determining whether or not a following relation expression (32) is satisfied which corresponds to a case where $\Delta(X,Y)$ is $\Delta(X,Y)=\widetilde{I}(X,Y^i)$ in the expression,

(32) $f(X)\cdot\overline{f(Y)}\cdot\widetilde{I}(X,Y^i)=0$,

or, by determining whether or not a following relation expression (33) is satisfied, which corresponds to a case where $\Delta(X,Y)=\widetilde{I}(X,Y^L)$ (for $\forall L\subset\Theta$),

(33) $f(X)\cdot\overline{f(Y)}\cdot\widetilde{I}(X,Y^L)=0 \quad (for \quad \forall L\subset\Theta)$,

or, by determining whether or not a following relation expression (34) is satisfied, which corresponds to a case where

$\Delta(X,Y)=\bigcap_{l}(x_l \cdot y_l \cup \overline{x_l} \cdot \overline{y_l} \cup \overline{\theta^l})$,

(34) $f(X)\cdot\overline{f(Y)}\cdot\bigcap_{l}(x_l \cdot y_l \cup \overline{x_l} \cdot \overline{y_l} \cup \overline{\theta^l}) = 0$

or, by determining whether or not a following relation expression (35) is satisfied, which corresponds to a case where $\Delta_j(A,B)$ in the expression (31) is $\Delta_j(A,B)=\bigcap_{l}(a_l \cdot b_l \cup \overline{a_l} \cdot \overline{b_l} \cup \theta_j{}^l)$,

(35) $\widetilde{F}(X,A)\cdot\widetilde{F}(Y,B)\cdot x_j \cdot \overline{y_j} \cdot \bigcap_{l}(a_l \cdot b_l \cup \overline{a_l} \cdot \overline{b_l} \cup \theta_j{}^l) = 0$; and,

dependencies of $f_j(X)$ of the variables $x_1,x_2,\cdots,x_n$ is analyzed in a lump by using the generating function;

the method further comprising computer executed steps of:

inputting each component function or a generating function of each mapping; and,

analyzing the variable dependencies based on the expressions (30)~(35).

8. The logic function design method of either of Claim 5 to Claim 7, further comprising computer executed steps of:

inputting relation among sets;

translating the inputted relation among the sets to characteristic logic functions using the relation expressions (8) to (14);

determining whether or not the resultant characteristic logic functions are satisfied;

inputting component functions and/or a generating function of each mapping;

calculating the each component function and/or the

generating function based on the expression (16);

calculating the expressions (18) to (29);

analyzing variable dependencies based on the relation expressions (30) to (35); and,

whereby .processes and determinations in connection with each mapping is treated in lump.

9. The logic function design method of Claim 3 or Claim 4, wherein, the base number r is r=2, and following expressions (1-b) to (5-b-2) are used for the encoding conditions, where component functions of the one or more operations of the old operation system, and the one or more operations, one or more encoders and one or more decoders are expressed by $G^q{}_O : g_i{}^q{}_O(X)$, $F^p{}_O : f_i{}^p{}_O(X,Y)$, $H^s{}_O : h_i{}^s{}_O(X_1, X_2, \cdots, X_T)$ and $G^q{}_N : g_j{}^q{}_N(X')$, $F^p{}_N : f_j{}^p{}_N(X',Y')$, $H^s{}_N : h_j{}^s{}_N(X'_1, X'_2, \cdots, X'_T)$, $\Phi : \phi_j(X)$, $\Psi : \psi_i(X')$, and a characteristic function $\chi_C(X')$ of a code domain is expressed by $c(X')$ with $i = 1,2,\cdots,n$, $X,Y,Z,X_1,X_2,\cdots,X_T \in B^n$, $j = 1,2,\cdots,m$, $X',Y',Z',X'_1,X'_2,\cdots,X'_T \in B^m$,

(1-b) $\widetilde{\Psi}(X,X')\cdot c(X')\cdot\widetilde{\Phi}(X',X) = \widetilde{\Phi}(X',X)$

(2-b) $\bigcup_{X'}\widetilde{\Phi}(X',X)\cdot\widetilde{\Phi}(X',Y) = \widetilde{I}(X,Y)$

(3-b-1) $\overline{\widetilde{G}^q{}_O(Y,X)}\cdot\widetilde{G}^q{}_N(Y',X')\cdot\widetilde{\Psi}(Y,Y')c(Y')\cdot\widetilde{\Psi}(X,X')c(X') = 0$

(3-b-2) $\overline{c(Y')}\cdot c(X')\cdot\widetilde{G}^q{}_N(Y',X') = 0$

(4-b-1)

$\overline{\widetilde{F}^p{}_O(Z,Y,X)}\cdot\widetilde{F}^p{}_N(Z',Y',X')\cdot\widetilde{\Psi}(Z,Z')c(Z')\cdot\widetilde{\Psi}(Y,Y')c(Y')\cdot\widetilde{\Psi}(X,X')c(X') = 0$

(4-b-2) $\overline{c(Z')}\cdot c(Y')\cdot c(X')\cdot\widetilde{F}^p{}_N(Z',Y',X') = 0$

(5-b-1)

$\overline{\widetilde{H}^s{}_O(Y,X_1,\cdots,X_T)}\cdot\widetilde{H}^s{}_N(Y',X'_1,\cdots,X'_T)\cdot\widetilde{\Psi}(Y,Y')c(Y')\cdot\widetilde{\Psi}(X_1,X'_1)c(X'_1)\cdots\widetilde{\Psi}(X_T,X'_T)c(X'_T) = 0$

(5-b-2) $\overline{c(Y')}\cdot c(X'_1)\cdot\cdots\cdot c(X')\cdot\widetilde{H}^s{}_N(Y',X'_1,\cdots,X'_T) = 0$.

10. The logic function design method of Claim 9, wherein further conditions for simplifying the one or more operators of the new operation system are imposed in addition to the expressions (1-b) to (5-b-2), and circuitry of the new operation system are simplified by designing the one or more encoders, the one or more decoders and the one or more operators thereunder.

11. The logic function design method of Claim 10, wherein

a following condition (48) is imposed to the unary operations,

(48) $$\widetilde{G}^{q}{}_{N}(X',A')\cdot\widetilde{G}^{q}{}_{N}(Y',B')\cdot x'_j\cdot\overline{y'_j}\cdot\bigcap_{l}(a'_l\cdot b'_l\cup\overline{a'_l}\cdot\overline{b'_l}\cup\overline{\lambda^{q}{}_{j}{}^{l}})=0$$

a following condition (49) is imposed to the binary operations,

(49) $$\widetilde{F}^{p}{}_{N}(X',A',C')\cdot\widetilde{F}^{p}{}_{N}(Y',B',C')\cdot x'_j\cdot\overline{y'_j}\cdot\bigcap_{l}(a'_l\cdot b'_l\cup\overline{a'_l}\cdot\overline{b'_l}\cup\overline{\theta_1{}^{p}{}_{j}{}^{l}})=0$$

$$\widetilde{F}^{p}{}_{N}(X',C',A')\cdot\widetilde{F}^{p}{}_{N}(Y',C',B')\cdot x'_j\cdot\overline{y'_j}\cdot\bigcap_{l}(a'_l\cdot b'_l\cup\overline{a'_l}\cdot\overline{b'_l}\cup\overline{\theta_2{}^{p}{}_{j}{}^{l}})=0$$

a following variable dependency condition (50) is imposed to the T-nary operations,

(50)

$$\widetilde{H}^{s}{}_{N}(X',A',C'_2,\cdots,C'_T)\cdot\widetilde{H}^{s}{}_{N}(Y',B',C'_2,\cdots,C'_T)\cdot x'_j\cdot\overline{y'_j}\cdot\bigcap_{l}(a'_l\cdot b'_l\cup\overline{a'_l}\cdot\overline{b'_l}\cup\overline{\mu_1{}^{s}{}_{j}{}^{l}})=0$$

$$\widetilde{H}^{s}{}_{N}(X',C'_1,A',\cdots,C'_T)\cdot\widetilde{H}^{s}{}_{N}(Y',C'_1,B',\cdots,C'_T)\cdot x'_j\cdot\overline{y'_j}\cdot\bigcap_{l}(a'_l\cdot b'_l\cup\overline{a'_l}\cdot\overline{b'_l}\cup\overline{\mu_2{}^{s}{}_{j}{}^{l}})=0$$

....

$$\widetilde{H}^{s}{}_{N}(X',C'_1,\cdots,C'_{T-1},A')\cdot\widetilde{H}^{s}{}_{N}(Y',C'_1,\cdots,C'_{T-1},B')\cdot x'_j\cdot\overline{y'_j}\cdot\bigcap_l(a'_l\cdot b'_l\cup\overline{a'_l}\cdot\overline{b'_l}\cup\overline{\mu_T{}^{s}{}_j{}^{l}})=0$$

to determine values of $\lambda^{q}{}_j{}^{l}$ and $\theta_1{}^{p}{}_j{}^{l}$, $\theta_2{}^{p}{}_j{}^{l}$ and $\mu_1{}^{s}{}_j{}^{l}$ to $\mu_T{}^{s}{}_j{}^{l}$ such as to reduce variable dependencies of the one or more new operators with inputs and outputs in comparison to the old operation system, and the one or more encoders, one or more decoders and the one or more operators are designed with the determined values, whereby a circuit scale and a delay time of the one or more new operators are reduced.

12. The logic function design method of Claim 9, wherein a condition of $\theta_1{}^{p}{}_j{}^{l}=\theta_2{}^{p}{}_j{}^{l}$ is imposed to aforementioned $\theta_1{}^{p}{}_j{}^{l}$ and $\theta_2{}^{p}{}_j{}^{l}$ of the binary operations, or a condition of $\mu_1{}^{s}{}_j{}^{l}=\cdots=\mu_T{}^{s}{}_j{}^{l}$ is imposed to aforementioned $\mu_1{}^{s}{}_j{}^{l}$ to $\mu_T{}^{s}{}_j{}^{l}$ of the T-nary operations to make the binary operations or the T-nary operations of a symmetric type.

13. The operation device design method of Claim 3 or Claim 4, wherein space $B_r{}^{n}$ of the old representation space $B_r{}^{n}$ is same as space $B_r{}^{m}$ of the new representation data ($B_r{}^{n}=B_r{}^{m}, n=m$); the one or more encoders Φ are isomorphic mappings such as $\Phi : B_r{}^{n}\rightarrow B_r{}^{n}$; and the one ore more decoders Ψ are such as $\Psi=\Phi^{-1}$ (inverse mappings of Φ).

14. The operation device design method of Claim 13, wherein:

the one or more encoders are determined to satisfy following expressions (51) and (55) to (57),

(51)
$$\bigcup_Y \overline{\widetilde{I}(Z,Y)} \cdot \widetilde{\Phi}(Y,X) = \overline{\widetilde{\Phi}(Z,X)}$$
$$\bigcup_Y \overline{\widetilde{I}(Z,Y)} \cdot \widetilde{\Phi}(X,Y) = \overline{\widetilde{\Phi}(X,Z)}$$

(55)

$$\widetilde{G}^q{}_O(X,A) \cdot \widetilde{G}^q{}_O(Y,B) \cdot \phi_j(X) \cdot \overline{\phi_j(Y)} \cdot \bigcap_l (\phi_l(A) \cdot \phi_l(B) \cup \overline{\phi_l(A)} \cdot \overline{\phi_l(B)} \cup \overline{\lambda^q{}_j{}^l}) = 0$$

(56)

$$\widetilde{F}^p{}_O(X,A,C) \cdot \widetilde{F}^p{}_O(Y,B,C) \cdot \phi_j(X) \cdot \overline{\phi_j(Y)} \cdot \bigcap_l (\phi_l(A) \cdot \phi_l(B) \cup \overline{\phi_l(A)} \cdot \overline{\phi_l(B)} \cup \overline{\theta_1{}^p{}_j{}^l}) = 0$$

$$\widetilde{F}^p{}_O(X,C,A) \cdot \widetilde{F}^p{}_O(Y,C,B) \cdot \phi_j(X) \cdot \overline{\phi_j(Y)} \cdot \bigcap_l (\phi_l(A) \cdot \phi_l(B) \cup \overline{\phi_l(A)} \cdot \overline{\phi_l(B)} \cup \overline{\theta_2{}^p{}_j{}^l}) = 0$$

(57)

$$\widetilde{H}^s{}_O(X,A,C_2,\cdots,C_T) \cdot \widetilde{H}^s{}_O(Y,B,C_2,\cdots,C_T) \cdot \phi_j(X) \cdot \overline{\phi_j(Y)} \cdot \bigcap_l (\phi_l(A) \cdot \phi_l(B) \cup \overline{\phi_l(A)} \cdot \overline{\phi_l(B)} \cup \overline{\mu_1{}^s{}_j{}^l}) = 0$$

$$\widetilde{H}^s{}_O(X,C_1,A,\cdots,C_T) \cdot \widetilde{H}^s{}_O(Y,C_1,B,\cdots,C_T) \cdot \phi_j(X) \cdot \overline{\phi_j(Y)} \cdot \bigcap_l (\phi_l(A) \cdot \phi_l(B) \cup \overline{\phi_l(A)} \cdot \overline{\phi_l(B)} \cup \overline{\mu_2{}^s{}_j{}^l}) = 0$$

....

$$\widetilde{H}^s{}_O(X,C_1,C_2,\cdots,A) \cdot \widetilde{H}^s{}_O(Y,C_1,C_2,\cdots,B) \cdot \phi_j(X) \cdot \overline{\phi_j(Y)} \cdot \bigcap_l (\phi_l(A) \cdot \phi_l(B) \cup \overline{\phi_l(A)} \cdot \overline{\phi_l(B)} \cup \overline{\mu_T{}^s{}_j{}^l}) = 0$$

;

the one or more decoders Ψ are determined such as $\Psi = \Phi^{-1}$; and,

the one or more operators of the new operation system are determined under variable dependencies $\lambda^q{}_j{}^l$ and $\theta_1{}^p{}_j{}^l$, $\theta_2{}^p{}_j{}^l$ and $\mu_1{}^s{}_j{}^l$ to $\mu_T{}^s{}_j{}^l$ for each new operation system by following expressions (52) to (54),

(52) $$\widetilde{G}^q{}_N(Y',X') = \bigcup_Y \bigcup_X \widetilde{G}^q{}_O(Y,X) \cdot \widetilde{\Phi}(Y',Y) \cdot \widetilde{\Phi}(X',X)$$

(53) $$\widetilde{F}^{p}{}_{N}(Z',X',Y') = \bigcup_{Z}\bigcup_{X}\bigcup_{Y}\widetilde{F}^{p}{}_{O}(Z,X,Y)\cdot\widetilde{\Phi}(Z',Z)\cdot\widetilde{\Phi}(X',X)\cdot\widetilde{\Phi}(Y',Y)$$

(54) $$\widetilde{H}^{s}{}_{N}(Y',X_1',\cdots,X_T') = \bigcup_{Y}\bigcup_{X_1}\cdots\bigcup_{X_T}\widetilde{H}^{s}{}_{O}(Y,X_1,\cdots,X_T)\cdot\widetilde{\Phi}(Y',Y)\cdot\widetilde{\Phi}(X_1',X_1)\cdots\widetilde{\Phi}(X_T',X_T)\ .$$